Remarks

Status of application

Claims 1-40 are pending in the subject application. Claims 1-40 stand rejected on the basis of prior art and under 35 U.S.C. Section 112, first paragraph. Applicant has filed this Amendment in conjunction with a Request for Continuing Examination. Applicant has amended the claims to address the Examiner's rejection under 35 U.S.C. Section 112, first paragraph and to further distinguish Applicant's invention from the prior art. In view of the below remarks and amendments herein, re-examination and reconsideration of the claims are respectfully requested.

The invention

Applicant's invention comprises a digital imaging system providing techniques for reducing the amount of processing power required by a digital camera device and for reducing the bandwidth required for transmitting image information to a target platform. The system only performs a partial computation at the digital camera employing an efficient color conversion process, using a GUV color space. After an RGB mosaic (image) is captured, the image is "companded" or quantized by representing it with less bits (e.g., companding from 10 bits to 8 bits). The image is then mapped from RGB color space to GUV color space, using a unique RGB-to-GUV transformation. Once converted into GUV color space, the image can be compressed (e.g., using wavelet transform-based compression), and then transmitted to any desired target platform. At the target platform, the GUV information may be restored in a non-compressed format and then further processed into a desired representation (e.g., standard format, such as JPEG).

This GUV-based methodology avoids the inefficiency of remaining in the RGB color space and avoids the computational complexity of converting to YUV color space, yet retains the benefits associated with YUV color space (e.g., de-correlation of image information). The methodology substantially reduces the compute-intensive tasks performed at the digital camera, such as interpolation of the image to full resolution and performing YUV transformations. The result is that the amount of processing necessary at the digital camera is substantially reduced. Further, the resulting compressed

luminosity record, because of its increased compression ratios (e.g., relative to conventional JPEG), facilitates wireless (or other limited bandwidth) transfer of images to target platforms.

Rejection under 35 U.S.C. Section 112, first paragraph

Claims 1-40 have been objected to under 35 U.S.C. Section 112, first paragraph, as failing to comply with the written description requirement. The Examiner has rejected claims 1 and 26 as containing limitations of transferring the companded image to the server computer and performing RGB to GUV transformation at a server computer that are not supported in the specification. By implication, the dependent claims of both are similarly rejected.

Applicant has amended Claim 1 and claim 26 to remove the recited limitation of "transferring the companded image to the server computer". Applicant has also amended claims 1 and 26 to remove the limitation that the transformation from the RGB color space to the GUV color space occurs at the server computer. Based on these amendments to independent claims 1 and 26, Applicant believes that the Examiner's rejection under 35 U.S.C., first paragraph is overcome.

Prior art rejections

A. Rejection under 35 U.S.C. Section 102

Claims 1-6, 22, and 26-30 stand rejected under 35 U.S.C. Section 102(e) as being anticipated by Acharya (U.S. Patent No. 6,392,699). Acharya describes an integrated color interpolation/color conversion technique involving the YCrCb color space. Applicant's approach involving conversion to the GUV color space is different than that described by Acharya in the '699 patent for the reasons described in Applicant's Appeal Brief filed on April 14, 2003 and the additional reasons described below.

The particular innovative feature touted by Acharya in the '699 patent is that color interpolation is integrated with color space conversion so that the two can be performed together (with particular efficiency gains realized). Applicant's invention takes a different approach by seeking to reduce the color interpolation and color processing performed at

the digital camera. Applicant's methodology avoids performing compute-intensive tasks such as conversion to the YUV color space until the image is transferred from the camera to another computing device having greater resources.

In particular, Acharya indicates in the '699 patent that his teaching pertains to performing an integrated color interpolation/color space conversion technique at the camera involving conversion to the **YCrCb** color space as follows:

> The invention in its various embodiments, particularly in providing a **12-bit YCrCb image that is directly converted from the captured 8-bit Bayer pattern,** reduces the storage requirements of the camera 730 and thus, the costs associated with that storage allowing for a more inexpensive camera.
>
> (Acharya, column 11 , lines 32-37, emphasis added)

In contrast, the destination color space in Applicant's color conversion process is preferably GUV, not YUV. Applicant's approach <u>avoids the expense of converting to the Y plane</u> (which entails, besides additional multiplication and addition operations, the expense of interpolating R and B values at each given location), by instead employing the G plane in the color space of Applicant's invention.

In one embodiment, Applicant's methodology for transformation to the GUV color space entails the computation of the following color values per cell, G0, G1, G2, G3, U, V (i.e., a single U and V for a cell):

```
G0 = (Ga+Gb+G1+G2)/4
G3 = (G1+G2+Gc+Gd)/4
U = R0-G0+255
V = B3-G3+255
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Here, the U plane in the GUV color space is computed from the particular Green pixels that are co-sited with corresponding Red pixels, which is referred to as `G0` in the above equations. Similarly, the V plane is computed from the particular Green pixels that are co-sited with corresponding Blue pixels; this is referred to above as `G3`. These differences are highlighted in Applicant's amended claim 1, at substeps (i) and (ii). Applicant's claims recite an approach that avoids conversion to the (computationally expensive) Y plane by instead deriving a primary channel (G) based on the Green pixels (and not Y, which is based on Red, Green, and Blue pixels). This is different than the

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conversion described in described in Acharya that involves the **Y**CrCb color space.

In another embodiment, Applicant's methodology provides for using the GUV color space but without sending interpolated Green pixel values (i.e., the G0, G3 values). In such an instance, the G plane transmitted from the client device to the target platform has half the pixels as the previous method. The G value is still interpolated at the client device to compute the secondary channels, but the G0, G3 values need not be compressed or transmitted to the target platform. These differences are highlighted in Applicant's amended claim 26, which includes the following claim limitations:

> transforming the image into a second color space having primary and secondary channels, the primary channel of said second color space comprising Green (G), including:
> interpolating the missing Green pixels from said RGB mosaic for purposes of computing the secondary channels of said second color space, and
> computing the secondary channels of said second color space as differences from the primary channel of said second color space, by differencing Red pixels with co-sited Green pixels interpolated from said RGB mosaic and differencing Blue pixels with co-sited Green pixels interpolated from said RGB mosaic; and
> after the image is transformed into said second color space comprising the Green pixels from the RGB mosaic and the computed secondary channels, transmitting the transformed image to a target platform.
>
> (Applicant's claim 26, emphasis added)

Applicant's approach avoids compressing and transmitting the G0, G3 values to the target platform, thereby reducing the image processing at the digital camera device and also reducing the size of the compressed image data that must be compressed and transformed to the target platform.

This teaching of performing only partial interpolation and avoiding the compression and transmission of interpolated color values finds direct support in Applicant's specification. For example, Applicant's specification provides:

> A first alternative to the above approach is to use GUV space but without sending the G0, G3 (interpolated) values. Here, these interpolated values are derived at the server. In such an instance, the G plane transmitted from the client device to the target platform has half the pixels as the previous method. The G value will

still have to be interpolated at the client device to compute the U value, but the G0, G3 values need not be compressed or transmitted to the target platform.

(Applicant's specification, page 52, lines 3-8, emphasis added)

Applicant's careful review of the Acharya '699 patent finds no teaching of deferring or performing only partial interpolation of the image data at the digital camera device as provided in Applicant's specification and claims. Instead, Acharya describes an integrated color interpolation and color space conversion process performed at the digital camera which is described as follows: "It would be desirable to design and provide a technique that **integrates the operation of color interpolation and color space conversion into a single operation**." (Acharya '699, col. 3, lines 43-46, emphasis added).

The integrated process described by Acharya involves both full color interpolation as well as conversion to a YCrCb color space at the digital camera. This is not Applicant's approach. Applicant's specification and amended claims 1 and 26 recite a methodology that avoids full interpolation of the raw image data at the digital camera and also avoids the conversion of the image data to the (computationally expensive) Y plane.

A claim is anticipated under Section 102 only if each and every element as set forth in the claim is found, either expressly or inherently described, in the single prior art reference. As Acharya fails to teach each and every element set forth in independent claims 1 and 26 (as well as dependent claims thereof), Acharya fails to establish anticipation of the claimed invention under Section 102. Accordingly, it is respectfully submitted that the the object under Section 102 is overcome.

B. Rejection under 35 U.S.C. Section 103

Claims 7-21, 23-25, and 31-40 stand rejected under 35 U.S.C. 103(a). The rejected claims are believed to be allowable for at least the reasons cited above pertaining to the Examiner's rejection under Section 102. In addition, these claims, which depend from independent claims 1 and 26, incorporate additional limitations which are believed to be allowable for the additional reasons specified in Applicant's Appeal Brief filed on April 14, 2003. As described in Applicant's Appeal Brief, the combined references do

not teach or suggest all of the claim limitations of Applicant's claims, and thus it is respectfully submitted that they do not establish prima facie obviousness under Section 103.

Conclusion

In view of the foregoing remarks and the amendment to the claims, it is believed that all claims are now in condition for allowance. Hence, it is respectfully requested that the application be passed to issue at an early date.

If for any reason the Examiner feels that a telephone conference would in any way expedite prosecution of the subject application, the Examiner is invited to telephone the undersigned at 408 884 1507.

Respectfully submitted,

Date: 12·30·03

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